REMARKS

DRAWINGS

Figures 3 and 4 were objected to because elements 326 and 422 included a misspelled word. Filed herewith are a set of replacement drawings correcting the spelling of "Weiner" to "Wiener".

SPECIFICATION

The Specification was objected to because "Wiener filter" was misspelled as "Weiner filter". With the present Amendment, the Specification has been amended to correct the spelling errors.

§112 REJECTIONS

Claim 24 was rejected under 35 U.S.C. §112. With the present Amendment, claim 24 has been cancelled.

§103 REJECTIONS

Claims 1, 6, 9 and 10

Claim 1, 6, 9 and 10 were rejected under 35 U.S.C. §103(a) as being unpatentable over Acero ("Environmental Robustness in Automatic Speech Recognition" IEEE 1990) in view of Pastor (US Patent No. 6,445,801).

Independent claim 1 provides a method of identifying a clean speech signal from a noisy speech signal. The method includes receiving a plurality of observation vectors each representing a separate frame of a noisy speech signal. A processor uses a prior model of clean speech and the plurality of observation vectors to determine a mean and covariance for a distribution of noise values. A processor uses the mean and covariance for the distribution of noise values, a respective observation vector, and the prior model of clean speech to compute an estimate for a clean speech value for each frame. A processor uses the mean and covariance for the distribution of noise values and a respective observation vector to compute an estimate for a noise value for each frame, where each estimate for the noise value is separate from the mean of noise values. A processor converts the clean speech value and the noise value for each frame to the spectral domain to form clean speech spectral values and noise spectral values. A processor

smoothes the clean speech spectral values over time and frequency to form smoothed clean speech spectral values, wherein smoothing over time involves smoothing clean speech spectral values for a frequency across different frames. A processor smoothes the noise spectral values over time and frequency to form smoothed noise spectral values. A processor uses the smoothed clean speech spectral values and the smoothed noise spectral values to set a gain for a filter for a frame wherein setting a gain for a filter for a frame comprises defining the gain as a ratio with a denominator of the ratio being the sum of the smoothed clean speech spectral value for the frame and the smoothed noise spectral value for the frame and a numerator of the ratio that is a function of the smoothed clean speech spectral value for the frame and the smoothed noise spectral value for the frame. The observation vector is applied to the filter to produce a filtered clean speech vector representing a segment of a clean speech signal.

With the present Amendment, claim 1 has been amended. Support for these amendments is found in FIG. 4 and in the Specification on page 14, line 1 - page 16, line 10 and in equations 8-21, 27 and 28 found on pages 18, 19 and 22.

Claim 1 is not obvious from the combination of Acero, Pastor and Arslan et al. (U.S. Patent No. 5,706,395, hereinafter Arslan).

First, neither Acero nor Pastor show or suggest smoothing clean speech spectral values over time and frequency to form smooth clean speech spectral values. In the Office Action it was asserted that Arslan discloses such smoothing in column 8, lines 14-40. Applicants respectfully dispute this assertion.

In the cited section of Arslan, Arslan indicates that a noisy speech signal is smoothed by "smoothing over neighboring frequencies". Thus, the smoothing performed in Arslan is a smoothing over frequencies and is not a smoothing over time. From one frame to the next, Arslan does not smooth the noisy speech signal. Instead, the smoothing performed by Arslan is performed within individual frames by averaging over 32 adjacent frequencies within a frame.

In addition, claim 1 is not obvious from the combination of Acero, Pastor and Arslan because there is no suggestion in any of the cited references for estimating a clean speech spectral

value for a frame and then using the clean speech spectral value to form a filter which is then used to filter an observation vector to form a filtered clean speech vector.

In Acero, estimates of clean speech vectors and noise vectors are determined using a minimum-mean-squared-error estimate and a maximum likelihood estimate. In Pastor, a Wiener filter is formed by estimating a noise mean for frames that do not include speech and applying the noise mean and a noisy speech signal to an equation that defines the Wiener filter. In column 6, lines 24-28, Pastor indicates that the clean speech signal is not used since it is not a directly accessible term.

In the Office Action, it was asserted that it would be obvious to replace the noisy signal in Pastor with the sum of the clean speech estimate and noise estimate formed in Acero. However, it would not be readily apparent to those skilled in the art that the clean speech estimate determined in Acero should be used to construct a filter that would then be applied to a noisy speech signal to determine a new clean speech signal estimate. Instead, those skilled in the art would have accepted the clean speech estimate provided by Acero as the final estimate needed. There would be no need to apply this clean speech estimate to construct a Wiener filter that is then applied against a noisy input signal to form a different estimate of the clean speech signal. Once one skilled in the art had attained a clean speech estimate using Acero, they would stop and accept that clean speech estimate. Pastor intimates this same idea by suggesting that the clean speech signal is not available. If the clean speech signal were available in Pastor, there would be no point in constructing the Wiener filter, which is only constructed in order to obtain an estimate of a clean speech signal.

Thus, there is no suggestion in the cited art for those skilled in the art to not accept the clean speech estimate provided by Acero. As such, there is no suggestion in the art to use that clean speech estimate to construct a Wiener filter that can then be applied against a noisy input signal to form a different clean speech estimate. Without such a suggestion, those skilled in the art would not make the substitution suggested by the Examiner since such a substitution adds unnecessary complexity to both Acero and Pastor without providing any clear benefit.

Since none of the cited references show smoothing clean speech values over time and frequency and since it would not be obvious to combine Acero and Pastor as suggested by the Examiner, the invention of claim 1 and claims 6, 9 and 10, which depend therefrom, are patentable over the cited combination of art.

Claims 13-23

Claims 13-18 and 21-23 were rejected under 35 U.S.C. §103(a) as being unpatentable over Acero in view of Pastor. Claims 19 and 20 were rejected under 35 U.S.C. §103(a) as being unpatentable over Acero and Pastor and in further view of Arslan.

Claim 13 provides a computer-readable storage medium having computer executable instructions for obtaining an estimate of a clean speech value and an estimate of a noise value derived from a noisy speech signal. A numerator of a filter gain ratio is set as a function of the clean speech value and the noise value. A denominator of the filter gain ratio is set as the sum of the clean speech value and the noise value. The filter gain ratio is then used in a filter that is applied to the noisy speech signal.

Claim 13 is not obvious from the combination of cited art. In particular, it is not obvious to obtain an estimate of a clean speech value from a noisy speech value and then use the clean speech value to form a filter that is then applied to a noisy speech signal.

As noted above, the purpose of Acero, Pastor and Arslan is to identify an estimate of a clean speech value. Once the estimate of the clean speech value is acquired, there is no need to apply the clean speech value to a filter given the teachings in Acero, Pastor and Arslan. In particular, if one has an estimate of the clean speech value, there is no need to construct a filter to be applied against a noisy speech signal as shown in Pastor and Arslan since one would already have the clean speech signal that is desired. Thus, it would not be obvious to those skilled in the art that after obtaining an estimate of a clean speech value, one should construct a filter using that estimate of the clean speech value.

Further, one would not replace the noisy signal in Pastor with a sum of a desired signal and a noise signal because Pastor teaches that the desired signal is not directly accessible but the

noisy signal is directly accessible. If the noisy signal is the same as the sum of the desired signal and the noise signal and is directly accessible, those skilled in the art would use the noisy signal in the filter instead of attempting to acquire the desired signal, which is not directly accessible. Replacing the noisy signal with the desired signal and the noise signal adds complexity to Pastor without providing any clear benefits.

Since it would not be obvious to obtain an estimate of a clean speech value and then use that estimate to set values for a filter gain in a filter that is applied to a noisy speech signal, the invention of claim 13 is patentable over the combination of Pastor, Acero and Arslan. Similarly, claims 14-23, which depend from claim 13, are patentable over the cited art.

Claim 20 is additionally patentable over the combination of Acer, Pastor and Arslan. In claim 20, obtaining an estimate of a clean speech value and an estimate of a noise value comprises smoothing the spectral domain clean speech value and the spectral domain noise value across time. None of the cited references show or suggest smoothing a spectral domain clean speech value over time.

In the Office Action, column 8 lines 14-40 of Arslan were said to show smoothing of a value over time. However, the cited section does not discuss smoothing spectral values over time but instead smoothes frequency values in a frame of a noisy signal over frequencies by averaging 32 adjacent frequencies. There is not indication that any values are being smoothed across time in the cited section. As such, claim 20 is additionally patentable over the cited art.

CONCLUSION

In light of the above remarks, claims 1, 6, 9, 10 and 13-23 are in form for allowance. Reconsideration of allowance of the claims is respectfully requested.

The Director is authorized to charge any fee deficiency required by this paper or credit any overpayment to Deposit Account No. 23-1123.

Respectfully submitted,

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